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The Geology of Phongum Razi Ranges Putao District, Kachin State

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Abstract

Kachin State is located in the northern part of Myanmar between India to the west and China to the east and north. The present study area covers the northwestern part of Kachin State including Putao Township. The proniment geographic feature of this area is the Mount Phongumrazi which is about (10500) feet height above sea level with snow caps in all seasons. This area is geologically still unknown and systematic geological investigation had never been studied yet. The study area is composed of mostly Igneous and Metamorphic rocks. The igneous rocks are biotite granite, hornblende biotite granite, peridotite and hornblendite. They are frequently cross cut by pegmatite, aplite veins and silica veins in numerous places. Most of these are found as massive and boulder in shape, and their sizes are very large amount to form as elevated mountain ranges distributing Putao township. The metamorphic rocks are intruded by igneous rocks. They are hornblende biotite gneiss, marble and hornblende biotite schist and garnet mica schist. They are shown as south plunging anticline structure in regional scale. The sedimentary rocks are found as Putao gravel and alluvium which are only observed at only Putao and neighbouring area. As economic point of view some Putao Jade (Grossular garnet) occurrence near upper Shangaung village, ruby and sapphire occurrences at Manse Kaung village and small scale placer gold mines are done by local people in numerous streams banks particularly at lower Shangaung areas .Granite are also used for road and construction materials and marble can be applied for raw material of cement industry.

Key words: Granite in Northern Myanmar, Phongumrazi region, Putao Jade and Placer gold.

Introduction

Kachin State is located in the northern part of Myanmar between India to the west and China to the east and north. The present study area covers the northwestern part of Kachin State including in Putao Township. (Fig.1). The prominent geographic feature of this area is the Mount Phongumrazi which is about (10500) feet height above sea level with snow caps in all seasons. It is composed of highly mountainous regions which are

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part of Tibetan Plateau to the north. This area is geologically still unknown and systematic geological investigation had never been studied yet. Therefore, the geological investigation is also required to prepare geological map of study area with fairly detailed and to record the possible mineralization and mineral resources.

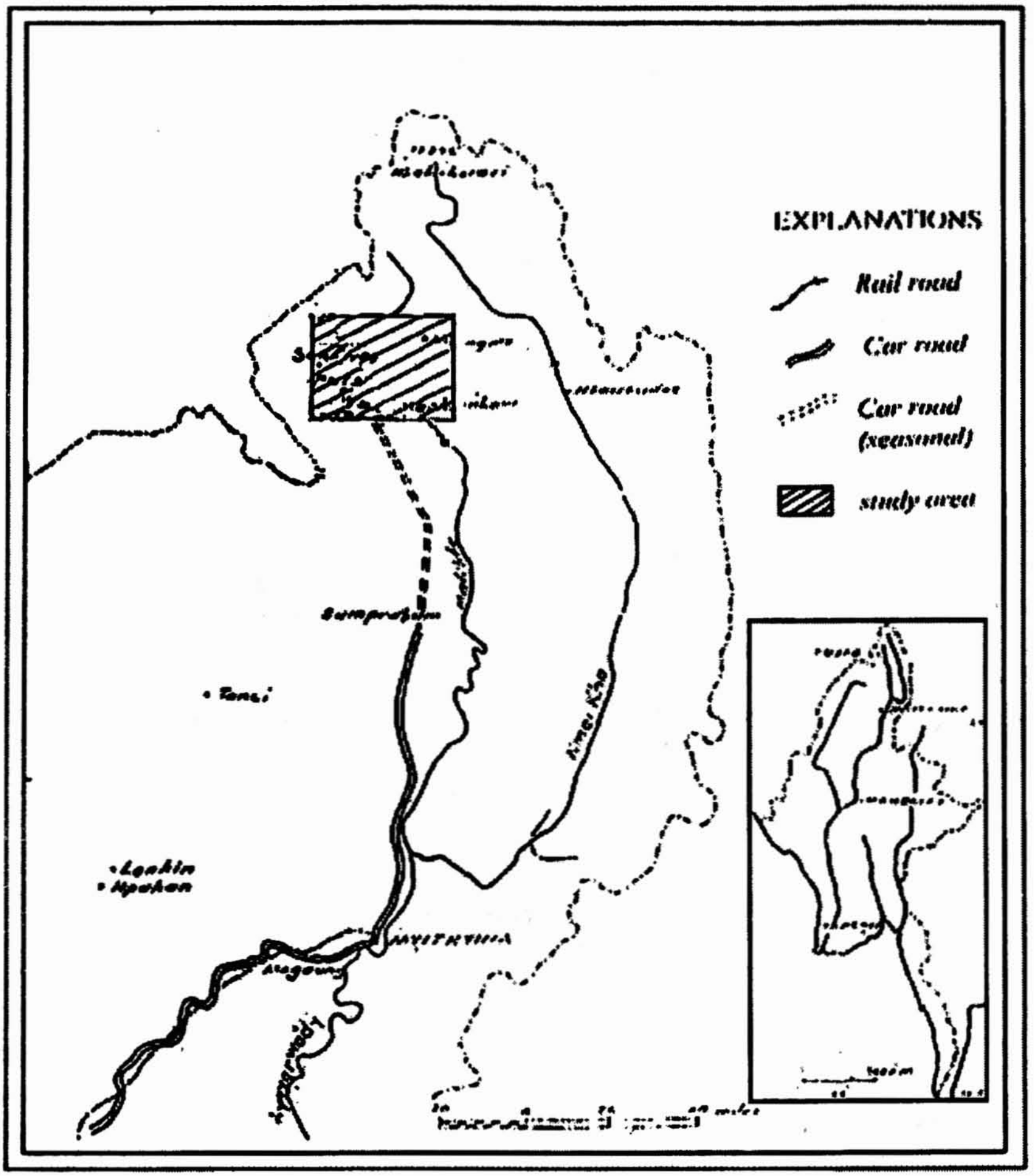

Fig. (1) Location Map of the Putao Area

This paper is one of the outcomes of the Phongumrazi Expedition of Myitkyina University which is an interdisciplinary and integrated approach on the combination studies of Botany, Zoology, Geology and Geography departments. This paper is an attempt to fill up a gap of geology knowledge of the northern Myanmar and its mineral resources.

The present area, covering part of 92 E-SE & NW of half-inch topographic maps, lies in the NW of Putao township. This area lying between Lat. N 27° 15'-27° 35' and Long. E 97°10' E-97° 30' is bounded by the Malikha river in the east and the boarder line of Myanmar and India in the west.

Due to the extensively dense vegetation and very rugged terrain, field traverses could be made mostly along the trials between the remote villages extending feebly along the hill ridges and stream banks. Severe weather condition of persistent rain and thick mist are another obstacle for field work.

Regional Geology

The geological knowledge of the northwestern part of Myanmar is very limited, however, their regional geological mapping based on air-photo study. According to one million scale geological map of Myanmar (Fig. 2), the eastern mountainous tract of Kachin State is generally included within the broad eastern most geotectonic belt of Myanmar, Shan- Tenasserim Belt. (Maung Thein, 1973). This belt extends southward through the Shan Plateau and Tenasserim ranges and northward to the eastern Himalayas and Yunnan province of China. It is composed of Late Precambrianm, Paleozoic and Mesozoic sequences. The crystalline rocks such as banded gneisses, crystalline schists, marbles, etc., of presumably Archean age are well exposed in this area. These rocks are known as undifferentiated metamorphioc units equivalent to Mogok series.(Bender,1983). Within these units, the acid igneous rocks mainly granitoid rocks are cropping out.

Previous Works

Within this area, very limited traverses were conducted by British geologist. Murry Stuart and H.L. Chhibber had described only generally certain parts of Kachin State in prewar days (Clegg, 1941). In this report Stuart (1919) while describing the galena occurrences NE of Putao differentiated the granite of this area into (a) Putao granite (b) Taron granite

and (c) Namtamati granite. He also reported that the occurrences of galena veins within silicious limestones in the Namtamai valley. Win Swe (1987) studied the lead-zinc prospect at the foot of Kalanggi Mountain, east of Machanbaw area. San Kyi et al (1989) studied the geology and economic aspects southwest of Putao area for the training purposes of Department of Applied Geology (DAG).

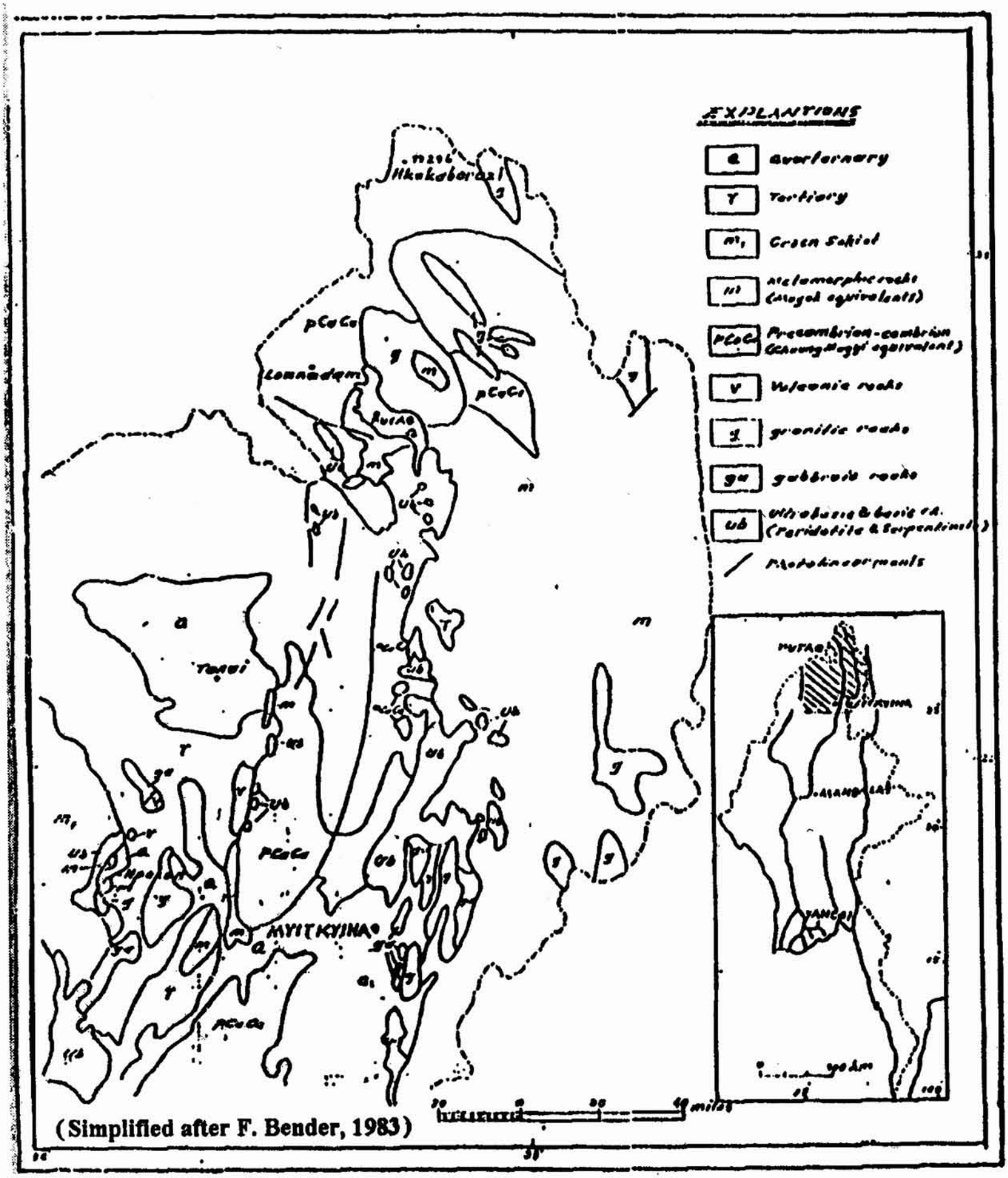

Fig (2) Location Map of the Putao Area

Geological Investigation

Field works took (20) days in Phingumrazi region, from (19-2-05) to (10-3-05), through (10) villages and (3) jungle camp and totally 320 km on foot. Most of rocks exposing in the area are crystalline rocks including varieties of granites and local exposure of crystalline metamorphic rocks, mostly gneisses, schists, slate, phyllite and small amount of marble. Altogether (250) rocks specimens were collected for petrological examinations.

Stratigraphy and Distribution of Rock Units

The study area is made up chiefly of metamorphic and igneous rocks with minor sedimentary rocks. According to the geological map of study area (Fig.3), the stratigraphy of rock units are as follows:

Rock type		Age
Sedimentary	Alluvium	Recent
	Putao Gravel	Pleistocene
Metamorphic	Hornblende biotite gneiss	
	Marble	Early Paleozoic ?
	Hornblende biotite schist	
	Garnet mica schist	
Igneous Rocks	Biotite granite	
	Hornblende biotite granite	Mesozoic ?
	Peridotite	Cetaceous to Early Eocene

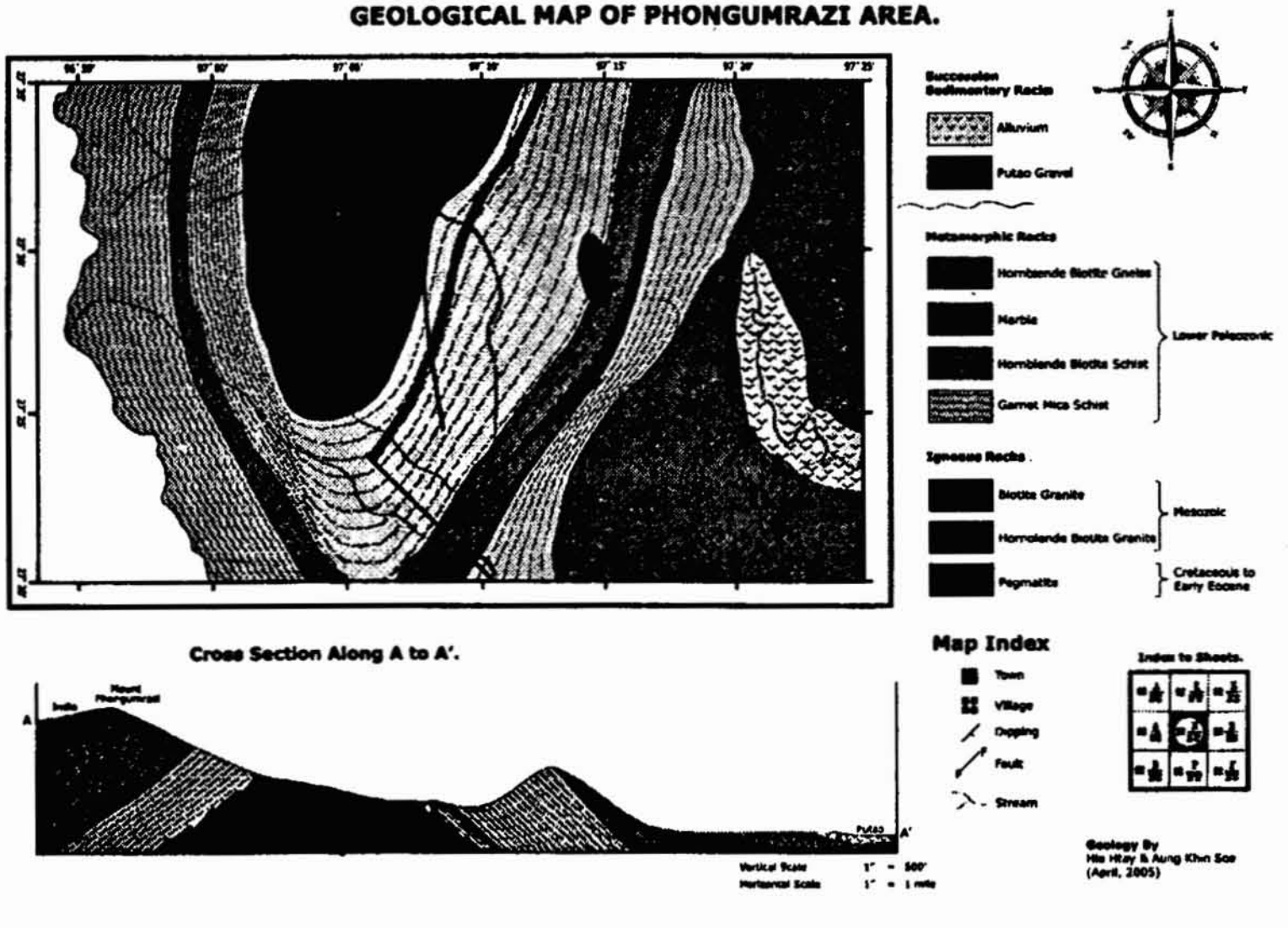

Fig. (3) Geological map of the Phomgumrazi area.

Meramorphic rocks

The metamorphic rocks in study area consist of hornblende biotite gneiss, marble, hornblende biotite schist and garnet mica schist. They are intruded by biotite granite, hornblende biotite granite and peridotite. The general trend of metamorphic rocks are NE-SW and NW-SE with dips of about 15' to 57' toward SE and NW direction. The unmappable unit of skarn is observed especially in contact with peridotite intrusion.

Hornblende-biotite schist

These rock units are the most prominent rock unit in the study area. Hornblende biotite schist is cropping out in the vicinity of Thitpingyi camp. (Loc. N27° 32.412' & E 97° 00.755'), Khantaukmyit camp (Loc. N27° 31.764' & E 96° 58.252') and view point area (Loc. N27° 31.443 & E 96° 57.949'). Their general trend is WNW-ESE and NE-SW, and dipping to the NNE-SSW and NE-SW with angle of 6° to 57°. They are well foliated

schistose texture in some places and mostly they are found as massive in character and they are showing distinct green colour due to the presence of hornblende. They are composed of hornblende, biotite, quartz and feldspars.

Garnet mica schist

They are mainly cropping out at Shangaung madin range (Loc. N27° 28.215' & E97° 12.978'), (Loc. N27° 29.722'& E 97° 10.420') and (Loc. N27° 30.762' & E 97° 09.282'). This unit is occurred as medium bedded to massive type in nature and abundant mica is muscovite. The small size, red colour granular form garnet found in mica, quartz and feldspars are showing granoblastic texture. The size of garnet is about 2 to 5 mm. Their general trend is NE-SW and dipping to the SE with angle of about 10° to 29°. In some places, they can be found as interbedded nature with the gneiss unit.

Marble

The exposure of this unit is found at (Loc. N27° 29.385' & E 97° 11.532') and (Loc. N27° 30.860' & E 97° 09.797'). It is well exposed as banded nature. This unit is intruded by leucogranite near Wasadam village. It is generally trending NW-SE direction and dipping toward the NE with angles of about 40° to 45°. It is fine to medium grained crystallined marble with grey colour on weathered surface and the pale blue to white on fresh surface At some places grey to red colour spinel minerals are containing in this unit. They are interbedded with schist unit near Wahsadan village.

Honnbende biotite gneiss

This rock unit is well exposed in the (Loc. N27° 26.547 ' & E 97°14.693 '),(Loc. N27°31.866' & E 96° 58.597') . It is locally occurred as interbedded with schist unit. In some places, this rock unit was intruded by pegmatite dyke, aplite dyke and quartz veins. Their general trend is nearly N-S to NW-SE with dipping toward E to NE about 6° to 40°. It is medium to thick bedded, fine to medium grained; moderately hard and compact felsic lamination is more common than mafic lamination in this unit.

Igneous Rocks

Major igneous rocks of present research area are biotite granite, hornblende biotite granite with minor amount of peridotite rocks. Moreover, hornblendite and leucogranite are also intruding into metamorphic rocks as unmappable units. Some amount of pegmatite veins, aplite veins and silica veins are observed at several places in the field.

Granitoid rocks

Biotite granite and hornblende biotite granites are containing in the granitoid rocks. They are mostly found as massive boulder in shape and forming as highly elevated mountainous regions then surrounding areas. Their commonly weathering features are exfoliation features. Generally, biotite granites are younger than hornblende biotite granites in the field. Petrographically, most of them are coarse-grained, faintly foliated, massive, hard and compact. Microscopically, they are composed of quartz, plagioclase, orthoclase, microcline, biotite, muscovite, hornblende and tourmaline as essential minerals and zircon, apatite, sphene, rutile, magnetite, titanaugite are accessory minerals. Most of them are coarse-grained and hypidiomorphic granular texture. The granitoid rocks of the study area lies in the Central granitoid belt. Therefore, it is related to the Late Cretaceous to Early Eocene igneous activities. (Khin Zaw, 1990)

Biotite granites are found at Ziadan village (Loc. N27° 34.360' & E 97° 05.887 ') and Chaungson camp (Loc. N 2° 33.225 & E 97° 02.669). It is intruding into garnet mica schist unit. This rock occur as huge bodies in Chaungson camp and Ziadan village.

Hornblende biotite granite is exposed in the eastern part of the study area. Good exposures can be seen near upper Shangaung (Loc. N27° 25.034' & E 97° 18.931') and Khalan village (Loc. N 27° 32.194' & E 97° 07.392'). The contact between hornblende biotite schist and hornblende biotite granite is seen near Upper Shangaung village where the granite intruded into schist along their foliation planes.

Peridotite

It is minor intrusive body in the study area. It is exposed at about 2 miles NE of Ahwadan village. It intruded into schists and gneisses units that showed the peridotite rocks are younger than the metamorphic rocks. They

are found as massive type in nature with partially to completely serpentinized. Major rock units are peridotite-pyroxenite namely as harzburgite and serpentinized harzburgite. In some places, they are transformed into serpentinites rocks.

Hornblendite

The unmappable unit of this rock type is found at near Ziadan village and Thitpingyi camp (Loc. N27° 32.412' & E 97° 00.735'). It is composed of very coarse grained hornblende minerals showing deep green colour.

Leucogranite

It crops out as a small unmappable body at about one mile north of Wahsadan village (Loc. N27° 29.358 ' & E 97° 11.530 '). It is intruding into hornblende biotite schist unit. It shows white coloured on fresh surface due to the abundant of quartz and feldspar minerals.

Sedimentary rocks

In the study area, sedimentary rocks occupy around Putao and its vicinities. The sedimentary beds are Putao gravel beds and recent alluvium.

Putao gravel bed

It is widespread and almost covering the whole Putao town itself is located on the small flat high-land of gravel bed which is about 2 miles in length, one mile in width and about 70 feet in height. On both sides of Malikha river, these gravel beds are well exposed. Gravel beds are composed of several sizes and several kinds of pebbles, gravels, cobbles and boulder, ranging from few inches to few feet in diameters. They are rounded, sub-rounded in shape. These gravel beds are overlain by yellowish, buff and reddish brown coloured soil of about 2 to 5 feet thick. Their age is probably Pleistocene.

Alluvium

Recent alluvium covers along the narrow stream valley in study area in which paddy, potatoes, maize and vegetables are mostly cultivated.

Petrogenesis

The igneous rocks of study area are included in the central granitoid belt of Myanmar according to Khin Zaw (1990). Abundant pegmatites and aplites are general characters of this belt. The granites in this area are transformed into gneissose granite. Granitoids of this belt were formed from calc-alkaline magma source of continental, sialic material. A total of (50) thin sections are collected and they are used for petrological and mineralogical investigations.

Form and Internal structure

They are commonly elongated and mostly parallel to the country rocks. Contact are mostly irregular and discordant but pronounced contact aureole was not found. Locally, the rocks show foliated structures at the margin and thus developed during emplacement. Strain or deformation sign was not shown in the minerals. All shapes and size of xenoliths are common in the granitoid and showed little alteration. Many apophyses commonly occur all along the granitoid rocks. Aplites and pegmatites veins and dykes are penetrating both granitoid and country rocks. They are frequently porphyritic as a primary lineation structure of feldspar phenocrysts show sub-parallel to parallel arrangements.

Country rocks and related metamorphism

In the study area, the country rocks are older Precambrian to Upper Paleozoic. They are mainly made up of gneisses, marble and schists of green schist facies. Generally, it is noted that the western part of country rocks are metamorphosed to greater extent than those of eastern part. Country rocks have already been affected by regional metamorphism and structural deformation occurred due to episode of granitoid intrusion during Mesozoic.

Level of emplacement

The granitoid rocks are medium to coarse-grained and frequently exhibiting porphyritic texture. The feldspar phenocrysts are mostly large and making parallel to sub-parallel alignment. Microscopically, alkali

feldspars are strongly perthitic and perfectly developed, cross-hatched twinning suggesting that they are maximum to near maximum microcline. The absence of pronounced contact aureoles, scarcity of comagmatic volcanic rocks and miarolitic cavities and the abundance of associated pegmatites and Aplite support a mesozonal emplacement. Muscovite can be easily differentiated in leucogranite that indicates the level of granitoid emplacement at a depth greater than 2.5 Km (Wones, 1981).

Age of emplacement

Chhibber (1934) suggested that the western edge of the Shan Plateau has been emplaced during Upper Cretaceous to Lower Eocene on the basis of stratigraphic reasoning. Yinmabin granitoid rocks intruded in Jurassic age (Maung Thein, et al 1972). Pyetkaywe granitoid emplaced of Mid-Jurassic to Lower Cretaceous age (Garson, et al 1976) Pyinmana granitoid intruded of Mid- Jurassic to Lower Cretaceous age (Bateson, et al 1972). The emplacement granitoid rocks of Kalaw-Pinlaung basin during Cretaceous (Myint Lwin Thein, et al 1981). Thus, stratigraphic evidences indicated that the age of the central granitoid belt (including study area) in Myanmar ranges can be regarded as Mesozoic.

Origin of Magma

The occurrences of perthitic maximum or near-maximum microcline implied that there are mesozonal, sub-solvus type. The general absence of pronounced contact aureoles and of comagmatic volcanic together with abundance of associated pegmatites and aplite veins and dykes are occurred which indicated that these granitoid rocks are mesozonal emplacement.

Additionally it is suggested that these were formed from a considerable wet, volatile-rich, moderately high temperature melt in a deep-seated environment. The water rich melt in this deep-seated condition allows very slow cooling to permit crystallization of maximum microcline and hydrous minerals such as biotite, muscovite and hornblende.

According to Khin Zaw (1990), the central belt granitoids including study area were derived from established continental, sialic materials, perhaps by remelting of the regionally metamorphosed, Precambrian to Upper Paleozoic metaclastic rocks.

Genetic types of granitoids

Chappell and White (1974) introduced the concept of two genetic types of granitoids, I-type (Igneous) and S-type (Sedimentary). They are derived by partial melting source materials – igneous and sedimentary. I-types and S-types are more positively and critically distinguished by chemical characteristics, mineralogical and field evidences.

Mineralogically, they cannot be easily regarded as I-type or S-type. Biotite +_ hornblende +_ Sphene +_ magnetite mineral association is characteristics of S-type. Apatite, accessory mineral, is also occurred as inclusions in biotite and hornblende which is a characteristic features of the I-type while it is also noted as larger discrete euhedral grains which is a characteristic features of S-type. According to these facts, the granitoids rocks in study area are shared by both I-type and S-type characteristics but many are akin to S-type. In these plutons, biotite muscovite granitoids occur as younger intrusive phases containing metasedimentary xenoliths. Thus, both I-type and S-type are present within a single pluton, but I-types are found as older units and S-types are younger plutonic granitoid units.

Geological Structures

The regional trend of metamorphic rocks are generally nearly N-S direction and locally NE-SW in the east and NW-SE in the west. They are folded and faulted in regional scale and intruded by granitoid rocks.(Fig.3)

Wahsadan Fault

It is trending nearly N-S direction and it is passing through the biotite granite, garnet mica schist and marble units. It may be normal fault and the age of faulting is probably after Mesozoic.

Ziadan south plunging anticline fold

Regionally, these metamorphic strata are folded in nature. The folded structure is south plunging asymmetrical anticlinal folds and their fold axis is trending nearly N-S and the plunging direction is toward south. Along the axial plane the biotite granite probably intruded into schist units. The time of folding is possibly Upper Paleozoic.

Economic aspect

Placer gold

Placer gold occurrences are wide spread along the stream channels of the study area. At Lower Shangaung area, the placer gold were mined by local people with semi -mechaniary equipments. By distribution, placer gold are abundant at this area due to the presence of quartz veins, aplite and acid pegmatite dykes are common, and widespread particularly pegmatites contain blue quartz which often is a good indicators of gold mineralization. Placer gold widespreadly occurs in the whole area. Therefore, potential for primary gold mineralization is considered to be high in this area.

Putao Jade

The occurrences of Putao jade are actually out in the study are, however, because it is a distinguished semiprecious minerals from those of the surrounding area. Grossular garnets of the Putao area is known as Putao Jade in the northern Kachin State of its green colour and jade like appearance. They are found in the eastern middle spur of the Singteng Madin, at about 4 miles WNW of Upper Shangaung village. Local people extracted these garnets and get rather high prices by selling as they regard these as jade of younger age (immature jade). They are very similar to typical jadeite jade. In fact, it is a green variety of grossulars, but it also posses either nice colours of green mottled in white, green mottled in fleshy colour, pink, olive green and white. They are metamorphic product in the contact zone of calcareous gneissic rocks and ultrabasic rocks. They can be used as semiprecious stones. This attractive green colour jade like grossular garnet is undoubtedly an economic aspect of this area. (San Kyi et al, 1989).

Ruby and sapphire in Marble unit

It is reported that small amount of ruby and sapphire can be extracted from marble unit near Manse Kaung village, however, only spinel can be encountered in this unit during study. Therefore, in near future, Manse Kaung may be an important area for the prospect of gem minerals. It is required to study later in detail.

Conclusion

(1) The igneous rocks of the study area are included in the central granitoid belt of Myanmar and they are the composit bodies of both I-type and S-type characteristics but many are akin to S-type.

(2) The crystalline rocks of the northwestern Kachin State are not only pervasively deformed but also they are subjected to higher grade regional metamorphism. These metamorphic rocks can be correlated with Mogok series by the similarity of lithologic units and the occurrence of spinal, ruby and sapphire in the marble unit.

(3) Quartz veins, aplite and acid pegmatite dikes are very common throughout the whole area appears that to be a good potential target area for gold exploration.

(4) The occurrences of grossular garnet which is well known as Putao jade at Upper Shangaung area is encouraging from the economic point for using semiprecious stones and decorative stones. Spinal from marble units can also be used as semiprecious stones.

(5) Due to the large amount of granitoid rocks of study area can be used for road construction materials and marble occurrences near Wahsandan area can be utilized for cement production for local development.

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